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Energy-based economic development

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ABSTRACT

The fields of economic development and energy policy and planning have converged in recent years to form an emerging discipline, which we term "energy-based economic development" (EBED). Despite the significant amount of stimulus funds, as well as state and local funding, that are being allocated to EBED initiatives in the United States, the emerging discipline has received scant attention in the energy, policy, and development literature. The link between energy and economic development in the literature is still theoretical, mostly focused on the need for and the potential benefits of EBED, and rarely applied. Furthermore, funding for EBED has outpaced understanding of the discipline, development of rigorous technical approaches, and meaningful ways to measure impact. Such information would not only help practitioners and policymakers more thoroughly understand the confines of the discipline and shape goals and approaches accordingly, but also help researchers identify, track, and evaluate a variety of activities in the field. With national and international attention focused on the convergence of these fields, researchers and practitioners have a rare opportunity to develop and implement the tools necessary to evaluate and communicate the potentially broader impacts that EBED may hold for society. If ways to leverage and sustain the injection of funds in this discipline are not identified, the opportunity may end before we can achieve either energy policy or economic development goals. In an attempt to respond to this need, this analysis explores the connection between energy and economic development, beginning with a review of the trends in each field and the goals that each seeks to achieve. On the basis of this information, we define the discipline of EBED, review the existing literature on it, and offer insights and perspectives on its emergence.

Contents

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1. Introduction

The American Recovery and Reinvestment Act of 2009 devoted over $50 billion to energy technology innovation, green jobs, and low-income energy efficiency assistance programs [1]. These efforts mark the convergence of two disciplines—energy policy and planning and economic development—and the expansion of a new field of practice and research, which we term "energy-based economic development" (EBED). EBED includes efforts that integrate both economic development and energy planning approaches.

Despite the indications that EBED is an important and growing discipline, the field is not yet well defined. A review of the literature reveals several unanswered questions about the theory and practice of EBED. For instance, what is it? What is our current state of understanding about it? Which approaches can government and community leaders take to incorporate EBED in their activities and initiatives? How do we measure the impact of these approaches?

The present analysis seeks to answer these questions and define the emerging field of EBED. Additionally, we clarify the subcomponents of EBED to minimize the use of vague or ambiguous descriptors prominent in current policy discussions. For example, the term "green" can be perceived and interpreted from both very broad and very narrow perspectives. "Green" can be a catchall phrase for any policy or initiative related to energy and the environment. Conversely, it can also convey a specific agenda, such as targeted measures to promote specific uses of renewable energy. "Energy" can also be an ambiguous term; to ensure clarity, for the purposes of this paper, all references to energy as it pertains to EBED will mean energy that is advanced, efficient, or clean.

- Advanced refers to technological innovation in either conventional or alternative sources of energy.
- Efficiency is the amount of energy input divided by energy output. Greater efficiency means that less primary energy is required for the same amount of output energy.
- Clean refers to energy that is low carbon—or, in some cases, no carbon—and also improves the environmental footprint vis-à-vis conventional energy sources.

This is in keeping with the definitions that have been provided by Gallagher et al. [2] for the field of energy technology innovation. Any mention of energy that does not follow this definition will be otherwise labeled.

Our analysis, which is primarily exploratory in nature, is based on extensive literature reviews and informal discussions and interviews with practitioners in the field. Although the field of EBED is not constrained to U.S. borders, for the sake of brevity this discussion is focused on U.S. trends. However, when applicable, we extend our discussion to include a consideration of the international context.

The value of performing this type of exploratory exercise—an attempt to document and discuss trends in an evolving field—cannot be understated. As established in the literature and discussed in subsequent sections of this paper, the field of EBED offers significant policy and planning opportunities to achieve simultaneous goals in the fields of economic development and energy. Past experiences with efforts in this field, however, are limited, so we have few lessons from which to draw. The policy "window" [3] or opportunity may be short-lived if we do not know how to implement EBED projects, identify the practices of greatest effectiveness and efficiency in different contexts, or evaluate these efforts. There is significant indication that the need for EBED will continue for decades, yet if we do not effectively maximize current opportunities, policymakers or their constituents may reject the field before EBED progress is effectively evaluated and becomes self-perpetuating.

The next section offers a discussion of how the practices and objectives of energy planning and economic development have evolved through the years and become more coordinated with and complementary to each other. In Section 3, we provide a working definition of EBED and review the goals and approaches that shape its practice. We review EBED funding trends in Section 4 and the EBED literature in Section 5. We conclude in Section 6 with a discussion of avenues of further EBED inquiry.

2. Economic development and energy policy and planning: evolution of the fields

2.1. The field of economic development

Economic development is a process of creating wealth for regions—nations or subnational regions such as states and counties—and improving the economic opportunities for the people that live and work within them. Desired results from this process include improved standards of living and reduced levels of poverty. Malizia [4] offers a broad but succinct definition of economic development:

> The ongoing process of creating wealth in which producers deploy scarce human, financial, capital, physical and natural resources to produce goods and services that consumers want and are willing to pay for. The economic developer's role is to participate in the process of national wealth creation for the benefit of local consumers and producers by facilitating either the expansion of job opportunities and tax base or the efficient redeployment of local resources (pp. 83–84).

This definition underscores the importance of wealth creation and the role of the developer in facilitating it. Bolton [5] defines economic development policies as those that assist places and people that are economically distressed where policy intervention can increase prosperity. Eisinger [6, p. 6] extends this to specify that economic development has as its ultimate intent to "enhance the collective well-being" of communities.

The practice of economic development has evolved significantly over time. Although scholars offer a variety of interpretations as to how the field has progressed,[1] we focus here on Eisinger's [6] depiction, in which the maturation of the economic development

[1] For instance, Bradshaw and Blakely [7] characterize the progress of economic development practice as taking place in three "waves." The first was marked by industrial attraction and characterized by programs to attract firms to relocate from the North to growing areas, such as the Southwest and South. In the 1980s the second-wave strategies emerged, in which economic development efforts targeted the retention and expansion of firms with indirect firm-level assistance. These practices evolved into third-wave strategies, which focused economic development efforts on growth-based strategies, as opposed to firm-based assistance.

practice is marked by a shift from supply-side to demand-side approaches among states. Eisinger contends that state and local[2] economic development practices, as they first emerged in the late 1800s and continued through the mid-1900s, emphasized primarily supply-side strategies. During this time, practitioners sought to recruit industry and business to their regions to create jobs and increase wealth. Supply-side strategies are marked by competitive efforts with other states to capture mobile capital and to locate (or "supply") this capital in the economic developer's home state or locality. Initiatives to relocate or retain capital are targeted mostly at the firm level and typically come in the form of low taxes on capital and labor or other government subsidies to reduce a firm's production costs. In these approaches, the government tends to follow the lead of private-sector decision-makers about which kinds of products and businesses to target and which investments to make. (See Eisinger [6, p. 12] for more specifics comparing supply- and demand-side approaches in economic development practice.)

Beginning around the mid-twentieth century, state and regional leaders shifted economic development efforts toward approaches that sought to increase entrepreneurial activity and generate global demand for locally made products and services (thus, "demand-side" approaches). These strategies are marked by support for entrepreneurship, innovation, and small business development and expansion. They seek to generate new capital through business creation and development by leveraging local assets and resources. Demand-side strategies also require active government involvement in market creation and development and make government responsible for guiding industries in directions that may be otherwise overlooked or underemphasized. This shift in focus from supply-side to demand-side strategies coincided with a variety of other economic transitions in the United States, including a change in the demographics of population centers, as populations moved from the North to the South and West; a devolution of economic development funding from the federal level to state governments; the globalization of economies; and the coinciding shifts in workforce requirements from manufacturing skills to technology-related skills and knowledge. The concurrence of these events raised interstate competition, which forced economic developers to experiment and broaden their approaches and forced states to seek greater income from state and local taxes for economic development purposes (Eisinger [6, pp. 10–11]).

This shift from pursuit of mobile capital to cultivation of local economic assets significantly shaped the evolution of modern economic development practices. A greater emphasis on demand-side approaches has led to a stronger and more dynamic relationship between the private and public sectors and encouraged governments to play a greater role in investment decision-making. Governments must therefore be more informed, proactive, and strategic. In general, public-private partnerships between government, businesses, and communities have grown in strength and prevalence [8]. Other trends marking modern economic development practice include the following.

- The field has replaced efforts focused on capital accumulation—including labor and land assets—with efforts focused on innovation and invention [8–13].
- Policymakers have improved the functionality and flexibility of tax subsidies and incentives that aim to attract and retain industry. They have also come to emphasize transparency and accountability in the design and implementation of these policy tools.
- Economic development strategies have shifted from a focus on agriculture and basic manufacturing to a focus on technology and advanced manufacturing. These strategies seek to establish a competitive advantage in the global marketplace.
- Guided by global competitiveness objectives, economic development efforts have shifted toward industrial development, organizational partnerships, and provision of value-added products and services that aim to enhance performance efficiency, improve the effectiveness of leadership, and develop technology.
- Cultivating and managing knowledge assets has evolved as an important component of innovation, entrepreneurship, and workforce development [8].
- The elevated importance of entrepreneurship and technological development has facilitated a greater role for higher education in economic development practice.
- In keeping with the trends outlined above, the field has expanded its notion of economic drivers to include venture capital and other equity capital markets; workforce and talent development and attraction; and university intellectual property and technology infrastructure including business incubators, science research parks, and sophisticated communication networks [14].

In the last quarter-century, the concepts of sustainability and the "triple bottom line" have also emerged in the economic development discourse and are gradually being incorporated into some practice [8]. At first, sustainability—and, more specifically, the environmental side of sustainability[3]—remained tangential to economic development research and practice because it was not deemed a significant driver of industrial recruitment, retention, innovation, or entrepreneurship. Over time, however, globalization trends have made sustainability a more important component of overall development, as explained by Stimson et al. [8]:

> Globalization is bringing about major changes to the flow of information and to governance systems, and the paradigm of sustainable development—the integrating of concerns for economic vitality, social equity and cohesion, and ecologically sustainable development—increasingly is being adopted as an underlying principle of regional development strategies and for planning practices.

This trend contrasts with the prior view of energy in economic development, where energy was typically considered only as one of many costs of production for companies making investment relocation decisions and energy-related expenditures were relatively minor compared with other inputs, such as physical infrastructure or labor. Recent increases in and volatility of energy costs, unpredictability of energy markets, desires for greater energy self-reliance, and emphasis on sustainability practices have pushed energy into more prominence in economic development.

2.2. The field of energy policy and planning

The field of energy policy and planning includes actions taken by government, not-for-profit, or private organizations to plan energy resource use, develop policy instruments to shape direct energy (i.e., heat) or secondary energy (i.e., electricity) production and consumption, and regulate oversight over energy resources. These efforts include issues spanning the full fuel cycle of all

[2] Economic development in the United States is performed primarily at the subnational, or state and local, level, with a relatively limited federal role in economic development activities. The federal government mostly sets rules and regulations and funnels federal resources for economic development to states. As such, this paper focuses on the role of integrating energy development approaches at subnational levels.

[3] Definitions of sustainability also include social and economic dimensions.

energy resources, including location, extraction, transportation, refinement, processing, combustion or other use, and waste disposal as well as supply-side, demand-side,[4] and information or knowledge energy resource management.

An abbreviated history of the energy policy and planning field over the past half century is as follows. Policies stemming from the New Deal provided the first, albeit very minimal, glimpse of energy policy and planning with the citing and building of new centralized power plants to meet rapidly increasing electricity demands. In the 1970s—when the United States confronted the oil shocks of 1973 and 1979, a nuclear mishap at Three Mile Island, and a growing consumer awareness of the deleterious effects of energy-related pollution—energy policy efforts expanded.[5] Energy planning became more popular during the 1980s, when many state utility commissions mandated that utilities create integrated resource planning programs to track resource use and facilitate demand-side management efforts.

After this flurry of activity, the focus on energy policy and planning faded as oil costs normalized and, with no perception of an imminent environmental threat, environmental concerns dissipated. This was the prevailing attitude until the mid-1990s, when the international community began to process issues related to climate change, including the potential economic burden associated with both the mitigation of and adaptation to climate change. As the 1990s progressed and a new century began, two additional factors raised the status of energy reform on many policymakers' agendas: energy fuel price volatility and a growing concern that dependence on foreign fuels was an economic security threat.

The coalescence of these three issues—climate change, energy prices, and energy security[6]—reaffirmed the significant connection, if not reciprocal relationship, between energy development and economic growth.[7] With minimal national leadership on energy and climate policy,[8] many state and local entities—both governmental and nongovernmental—stepped into leadership roles by initiating efforts to increase diversification of energy sources, increase energy self-sufficiency, or both. Instead of focusing on carbon mitigation policy, many of these energy policy and planning reforms pursued revamped initiatives on economic development grounds [18,19], in pursuit of "home-grown" energy [18] or as a means of diversification of state or regional economies to improve competitiveness. One reason for this approach is that, although alternative energy industries are immature compared with conventional energy industries, they represent opportunities for substantial investment and growth. Thus, many state and local energy strategies are attempts to "stay ahead of the curve," gain an early market share, and profit from future energy developments. Another explanation, however, is that framing energy reform on economic development grounds makes energy policy inherently less partisan and more politically feasible—rarely do policymakers contend that economic development is an ill-advised objective, but energy for the sake of climate change mitigation or reduced dependence on foreign fossil fuels is not as universally accepted. Furthermore, efforts framed in economic development discourse obviate the need for policymakers and their constituents to agree on which of the many energy or climate change challenges are most threatening; such framing instead provides a platform for energy reform that has the potential to address multiple issues simultaneously, but with the least political tension.

As state and local energy policy and planning efforts have gained momentum over the past 15 years, the efforts have become increasingly focused on energy technology innovation, which is defined as

> The set of processes by which improvements in energy technology, which may take the form of refinements of previously existing technologies or their replacement by substantially different ones, are conceived; studied; built, demonstrated, and refined in environments from the laboratory to the commercial marketplace; and propagated into widespread use [2, p. 195].

In other words, energy technology innovation focuses on innovative development and deployment of efficient, reliable, advanced, and low- to no-carbon energy technologies, including demand- and supply-side technologies. These technologies are intended to serve one of two roles: (1) as a replacement or enhancement to conventional sources of energy; or (2) to "leapfrog" or completely bypass technologies based on conventional sources in favor of more advanced technologies.

States and localities continue to play a leading role in shaping energy policy and planning, and they demonstrate the expanded role for government intervention and public policy efforts in energy markets. Policymakers in the energy technology innovation field use a variety of different policy instrument combinations that aim to provide incentives for the development and deployment of innovative energy technologies. Policy instruments tend to include flexible and market-based instruments, financial incentives (e.g., research and development grants, public benefit funds, tax incentives), or hybrids of different instruments that demonstrate elements of both command-and-control and market-based designs (e.g., the renewable portfolio standard). States, regions, or local governments tend to choose among a variety of instrument options and to specifically tailor the selected instruments to their local needs and circumstances. Policy efforts in this field also aim to establish functional and working relationships between public and private actors. Similar to the economic development discipline, states and localities have emerged as the laboratories for policy development and implementation in energy policy and planning.

3. Convergence of the fields: funding and activities

As shown in the discussion of evolution of the two fields, economic development and energy policy and planning have begun to converge. Both theory and practice in economic development have come to emphasize local asset-based competitiveness, technology innovation, local or regional scale, and a growing significant role for public policy and public-private partnerships in shaping the development of economies. Similarly, the field of energy policy and planning has evolved to emphasize local resources, technology innovation, a mix of policy interventions mostly implemented at the subnational level, and functional

[4] In contrast with the economic development concepts of "supply-side" and "demand-side" introduced in the previous section, "supply-side" in the energy context refers to the resources and technologies used to produce energy. "Demand-side" refers to factors and approaches related to energy consumption, e.g., energy efficiency and load control.

[5] New federal legislation in the 1970s included the National Environmental Policy Act (NEPA), the 1977 Clean Air Act, and the National Energy Act of 1978, which included the Public Utility Regulatory Policies Act (PURPA). The Carter administration also created the Department of Energy in the late 1970s.

[6] One could argue that other factors were at play and also significantly shaped the direction of U.S. energy policy and planning during this period. For instance, electricity reliability concerns, as made most evident by California's 2000 and 2001 blackouts, also contributed to energy's growth as a policy priority.

[7] It is important to note, however, that the connection between energy and economic development was established more concretely in the international development realm over two decades ago. The importance of energy access as it relates to the primary needs of all individuals, economic well-being, and personal standards of living, has been established firmly in the literature and has gained verification by the development community [15–17].

[8] The national government was involved in energy policy efforts during this time as well, but these efforts—including the Energy Policy Act of 1992, Order 888, Order 889, and Order 2000—were mostly focused on increasing competition in the electricity sector.

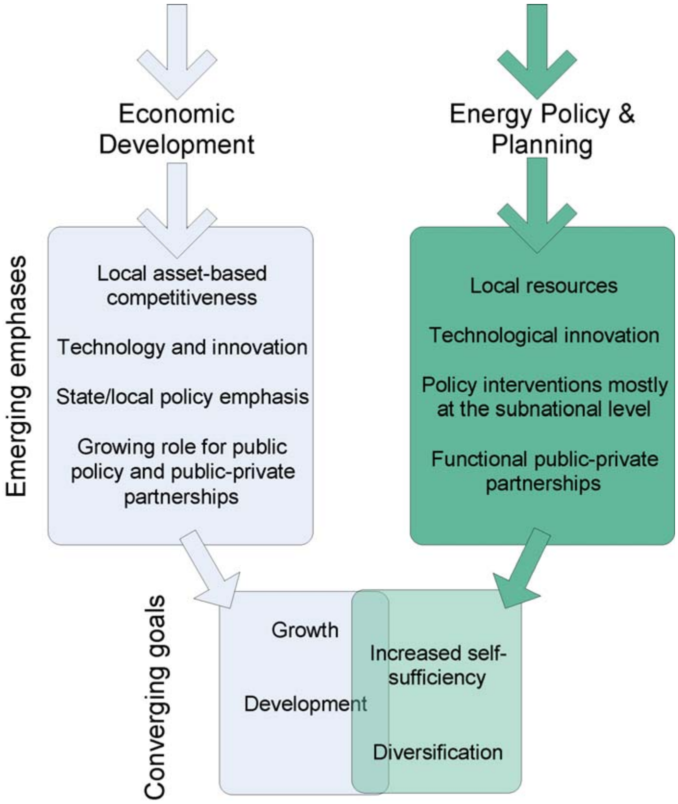

Fig. 1. Parallel evolution and converging goals of the fields of economic development and energy policy and planning.

public-private partnerships. It is now becoming common to find economic development initiatives that involve energy strategies, or energy policy and planning initiatives that involve economic development elements. The evolution and current trends in each field, as shown in Fig. 1, demonstrate a support of development and progress in the other and, thus, a greater integration of the two movements.

In addition to parallels in how the fields have emerged, the goals of each discipline frequently complement those of the other. Energy policy and planning seeks to improve energy self-sufficiency (which can result in the creation of businesses that are unlikely to relocate outside a given region) and increase energy diversification (which can result in the creation of new technologies, businesses, and jobs). Economic development initiatives may seek to catalyze growth through innovation, which can result in increases in energy efficiency or the creation of new technologies that diversify a given region's sources of direct or secondary energy.

3.1. Funding

Funding and investment at the intersection between economic development and energy policy and planning has also been on the rise over the last decade, further driving the convergence. According to the most recent United Nations Environment Programme's Sustainable Energy Finance Initiative (UNEP-SEFI) report, *Global Trends in Sustainable Energy Investment 2009*, global investment in sustainable energy companies or projects totaled over $155 billion during 2007 and 2008, a tremendous amount of growth from approximately $22 billion in 2002.[9] Most of these funds were invested in renewable energy technology research and deployment, in such areas as biofuels, geothermal, wind, hydroelectric, solar, and marine energy. Although many sectors of the economy saw a decline in investment during the recent global economic recession, investment has continued to grow—if at a slower pace—for alternative energy projects. Stimulus packages from various countries have allocated significant funds to energy projects. More specifically, national economic stimulus packages have earmarked roughly $180 billion to $200 billion for energy projects [1,20], with the following countries ranking high on the list for recovery plans incorporating energy supply and energy efficiency components.

- China: ~$70 billion for electricity grid upgrades and $12 billion to energy conservation and environmental protection projects.
- United States: ~$68 billion (described in further detail below).
- Japan: $11 billion for energy efficiency.
- South Korea: $8.5 billion for energy efficiency projects.

The American Recovery and Reinvestment Act (ARRA) of 2009 is the U.S. effort to create and retain jobs and stimulate the national economy. To achieve one of its secondary goals of jumpstarting the transformation of the nation's energy infrastructure through energy generation technologies, ARRA allocated billions of dollars in funding to energy provision and energy efficiency projects; workforce development and training; and research and development for alternative, advanced energy, and energy efficiency technologies.

As shown in Fig. 2, ARRA also made $21 billion available for tax incentives to alternative energy manufacturers and more than $30 billion for direct spending [1].

3.2. Activities

Fig. 3, updated and adapted from Roberts [21], characterizes the relationships between a selection of activities typically undertaken within economic development and those undertaken as part of energy policy and planning. The overlap of these activities further underscores the notion of convergence of fields and indicates activities with the strongest connections. The activities listed in the

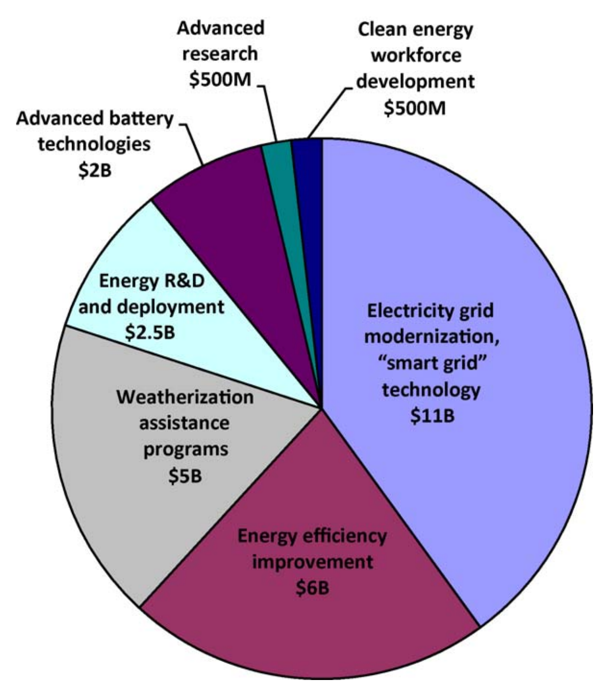

Fig. 2. Distribution of EBED-related ARRA direct spending. EBED, energy-based economic development; ARRA, American Recovery and Reinvestment Act; R&D, research and development; $M, millions of dollars; $B, billions of dollars.

Energy / **Economic Development**	Weatherization & upgrades to facilities	Energy efficiency assessment	Conservation assessment	Policy measures (RPS, tax incentives, etc.)	Integrated resource planning	Energy education	Energy access & expansion	Infrastructure	Research & development	Alternative resource assessment
Planning and development	●	●	●	●	●		●	●		●
Business attraction		○		○			●	○	○	
Business retention	○	●		○			●	○		
Encouraging entrepreneurship and start-ups		○		●			●		●	●
Industry cluster/sector development				○	○		●		●	○
Workforce development	●	○	○	○		○		○		
Education (K-12, higher education, STEM/creativity, etc.)			●			●			○	
Policy (tax, fiscal, incentives, etc.)	●			●	○			○	●	
Cultivate ecosystem/business climate		●	●	●	○	●	●		○	○
Quality-of-life enhancements	●	○	●				●	●		●

Strong relationship ●
Relationship ○

Fig. 3. Intersection of economic development activities with energy policy and planning activities.

figure are not all-encompassing, and there are subsets of important activities within each of these categories. However, Fig. 3 is important because it does demonstrate the major activities within each practice and how they intersect.

4. Definition, goals, and approaches

4.1. Definition of energy-based economic development

Despite the demonstrated overlap in focus areas and convergence of goals across the two fields of economic development and energy policy and planning, a single, agreed-upon, widely used definition of the emerging field of EBED does not yet exist. In the United States, this lack of shared understanding, in combination with the sudden injection of stimulus funding for activities at the intersection of the two fields, has resulted in significant confusion. The use of "green" as a catchall phrase for activities that involve energy or the environment is an example of this confusion. This confusion is harmful to the new field in a number of ways, including the following:

1. Attention has been focused predominantly on clarification of terminology and classification of activities, hindering the development of meaningful, comprehensive approaches that effectively incorporate the goals of both fields.
2. The absence of a definition and shared terminology has potentially resulted in the allocation of funds to projects that claim to meet both energy and economic development objectives but do not, thereby enervating the effectiveness of the allocated resources.
3. Inconsistent information and short funding horizons make it difficult to establish metrics and mechanisms for evaluation of activities, further hindering the development of the field and, more importantly, the identification of successful approaches and practices.

More clearly defining the field and the approaches within the field will help practitioners manage resources, implement projects, evaluate outcomes, and advance successful methods. To that end, we offer the following definition.

> Energy-based economic development is a process by which economic developers; energy policymakers and planners; government officials; industry, utility, and business leaders; and other stakeholders in a given region strive to increase energy efficiency or diversify energy resources in ways that contribute to job creation, job retention, and regional wealth creation.

This definition is broad, but it is a marked contribution to the field for three important and distinct reasons:

- It encompasses the array of benefits that can converge under the disciplines of energy policy and planning and economic development. For example, whereas the more narrow interpretations of ambiguous terminology such as "green" may not value technologies that improve the efficiency of oil and gas extraction, this definition recognizes that these processes do increase energy efficiency and perhaps retain jobs for a region.
- It holistically describes the convergence of energy policy and planning and economic development, allowing for a wide set of policies and practices directed at the goals of EBED (see Section 4.2 for a description of EBED goals). In short, the goals are

[9] These estimates are extracted from the funding summaries most readily accessible via public-access Internet research.

increased energy efficiency, diversification of energy resources, job creation and retention, and regional wealth creation. This framework, more expansive than previous definitions, creates a greater opportunity to generate a host of EBED activities and initiatives.
- It allows for alignment between the goals and objectives of community stakeholders and energy policy and planning activities, which in turn grounds energy-related initiatives with a wider set of local champions. Before this convergence, energy policy and planning decisions were typically made by utility companies, regulators, and policymakers. Incorporating economic developers, community development practitioners, local officials, and others builds a more robust framework for cross-fertilizing activities among different types of stakeholders. The result is the potential generation of more innovative, more prolific local and regional problem-solving of EBED issues.

4.2. Goals of energy-based economic development

To expand on the goals set forth in the definition, and to demonstrate the potential range of EBED activities, we divide EBED goals into four, not mutually exclusive, categories.

Increasing energy self-sufficiency, the first goal, originates from the energy policy and planning field. The national focus on energy security—the notion that a dependence on energy sources that come from outside of a jurisdiction's borders poses a risk to the economic and personal security of that jurisdiction's inhabitants—has translated to similar focus on energy "independence" at a subnational level. At a national level, these potential risks are of particular importance when the energy resources are extracted from regions that are politically instable or that may be susceptible to natural or terroristic disasters [22]. As energy prices rise and regions must spend a greater share of their fiscal resources on imported energy resources, the perceived need to replace imported energy with home-grown energy continues to rise. At a subnational level, the focus is less on actual security and more on regional competitiveness, potential for job creation and retention, or the utilization of resources. This increased focus on local and regional resources aligns well with the push for increased use of alternative resources, because advanced, alternative energy tends to come from local or regional sources.

The second goal is *energy diversification*, which refers to the development and use of new or alternative resources or technologies that emit fewer greenhouse gases or other environmental pollutants and are more efficient. Energy diversification has the potential to increase energy reliability and provide enhanced energy security through reduced dependence on sources that exhibit volatility in fuel price.

The third and fourth EBED goals are *economic growth* and *economic development*. Economic growth refers to the creation of jobs or expansion of business activity, which increases personal and household incomes and, in turn, the local or state tax base and larger macroeconomic indicators such as gross domestic product and industry growth as defined though increased revenues. Economic development adds an element of qualitative improvement to the quantitative focus of growth. It may include catalyzing activity in new and emerging industry sectors to diversify the regional economy and better absorb regional economic shocks. Economic development also works to improve factors that contribute to a healthy economy, such as business climate, workforce, healthcare provision, education, and quality of life.

4.3. Approaches to energy-based economic development

Describing the four goals of EBED is important because it sets the stage for crafting meaningful approaches for implementation by practitioners in communities, states, regions, and countries. With this transition from goals to approach, it is useful to discuss process as an important factor in creating approaches for implementation. We introduce process through the lens of economic development planning because it is well established and encompasses a variety of issues. The planning process generally follows a path that includes the following elements: stakeholder engagement, identification of goals and objectives, assessment of assets and gaps that enable or constrain attainment of goals and objectives, comparison and selection of alternative interventions, implementation, and evaluation. Outcomes are measured against the goals and objectives initially established, with this feedback creating a circular process. The EBED process is similar, but diverges in several key ways:

- Utility operators and landowners or regulators of natural resources will be critical stakeholders.
- The data and information gathered in the assessment phase will include additional indicators (e.g., energy capacity and demand forecasts, energy efficiency resource potential, renewable energy resources).
- The toolbox of potential interventions includes additional activities, as detailed below.

As is the case with standard economic development, identification of appropriate interventions will depend on regional context—the region's assets and gaps, goals and objectives. Following are illustrative EBED approaches.

- Regional economic development practice in the United States focuses heavily on specialization, that is, on competitiveness within a few industries in which a given region has some advantage or concentration. Given this context, many economic development interventions fall within the category of *industry development*—policies and initiatives that aim to increase business activity (e.g., sales, revenues, jobs) within a certain industry sector or interrelated set of industries, generally to increase or diversify the tax base. These interventions may include targeted business recruitment, retention or expansion support of businesses in a target industry, policies that improve the business climate for a target industry, or initiatives that support the creation of new businesses within a target industry. Industry development in the EBED context might aim to increase regional economic activity within the wind power, hydropower, solar energy, biofuel, or geothermal energy industries.
- The creation and support of new businesses is a key driver of regional economies, with recent research showing that firms younger than 5 years account for nearly two-thirds of job creation in the United States [23]. *Entrepreneurship development* policies and programs provide potential entrepreneurs with the capital and technical assistance they need to start and grow their businesses. As in industry development, an EBED entrepreneurship initiative might target potential entrepreneurs in the wind power, hydropower, solar energy, biofuel, or geothermal energy industries.
- New and existing businesses alike depend on innovation, especially in emerging and quickly evolving clean energy industries. To support these industries, regions need an effective and seamless infrastructure for the creation of new ideas and their transfer to market. EBED *research and innovation support* strategies strengthen, link, or create regional assets for knowledge creation and transfer to create, sustain, and grow energy businesses.
- All three of the preceding types of strategies—and regional competitiveness itself—depend heavily on the availability of educated, skilled human capital. *Workforce development*, broadly, describes the public- and private-sector policies and programs

that provide individuals with the means and opportunity to obtain employment and that provide companies the skilled employees they need to compete. As energy companies form and develop, they will increase demand for employees with skills and training in existing and new occupational categories. Meeting this need will require such varied activities as (1) enhancing the energy knowledge of workforce service providers and updating existing curricula to include alternative energy concepts and skills and (2) forging new partnerships between educational institutions and employers to design new curricula, certifications, and degrees.
- *Energy self-sufficiency* approaches include weatherization strategies; the development and deployment of energy efficiency technologies; the development and deployment of smart-grids; the use of distributed generation; improved manufacturing processes and product development; and development of energy technologies that employ local resources or other technologies that use local energy inputs.
- *Diversification of energy resources* includes the expansion of energy access and the development and deployment of advanced, efficient, and low- to no-carbon sources of energy.

5. Literature review

Despite the nascence of the field, given the convergence described above and the funding allocated toward these activities, the sheer amount of recent discussion of EBED in both the peer-reviewed and other literature comes as no surprise. Supporting the discussion in the prior section, a review of these studies reveals that the link between energy and economic development is still primarily conceptual and theoretical, mostly focused on the need for and the potential benefits of EBED, and is only rarely applied.

The literature is divided into five categories: the need for and opportunities of EBED; the benefits of such efforts; methodological approaches to EBED assessments; calls for a comprehensive approach to EBED; and complications to success in this discipline.

5.1. Needs for energy-based economic development

A number of authors have cast the EBED process and a subset of it, “green” economic development approaches, as representing a clear opportunity to bring together two divergent fields and their respective stakeholders (examples include Blue-Green Alliance, Ong and Patraporn, and Toman and Jemelkova [24–26]). Those looking for a pathway by which new measures can be undertaken to improve the energy system have found themselves looking at economic development stakeholders as effective political allies. Concurrently, economic development professionals increasingly view the energy system as a source of potential economic opportunity.

The body of literature in this category is divided by which field it draws on more heavily: it either focuses on the potentially significant role of economic development to address the demand for decarbonized energy consumption and improved energy self-sufficiency; or it focuses on the role of energy-related industries, technologies, and processes to drive job creation and industry retention [27,28]. Those focused on the former see EBED as a means to take energy policy beyond its traditional environmental framework, moving beyond quotas, emissions limits, and pollution prices, toward a discussion about investment in infrastructure to promote robust economic development and improved standards of living [29].

5.2. Impacts and benefits of energy-based economic development

The literature on the benefits of EBED focuses primarily on the potential for job creation associated with increased investment in energy supply and energy efficiency. In many cases, researchers [26,27,29,30] contend that a large percentage of this employment is made up of jobs that are guaranteed to remain domestic (i.e., they are not at risk of being fulfilled by overseas labor), because the installation of energy systems involves site-specific installation and construction. Atkinson et al. [31] have highlighted the need for the United States to significantly increase its investment in research and development, as part of a longer-term EBED strategy, to remain globally competitive.

Another common focus of the literature is the economic development potential of energy efficiency measures. In addition to energy efficiency’s offering the opportunity for new job creation—because of an increase in construction and installation jobs—it also provides cost savings from unspent energy budgets that can be redirected toward other sources of economic activity [32–34]. Ultimately, a common conclusion of many works in this field is that the creation and adoption of low-carbon energy technologies aimed at energy generation and efficiency tend to create more jobs per unit of installed capacity than conventional approaches. Despite this commonality in the literature, comparing the various studies devoted to this topic is difficult because the key inputs used in these analyses are significantly inconsistent: the technologies examined, the regions studied, the types of employment effects (i.e., direct, indirect, and induced), and even the definition of what constitutes a “job” (full-time or part-time, temporary or long term). Differences in these inputs and other assumptions have led to a wide variety of job growth estimates and multipliers for EBED and have contributed to the confusion discussed in the preceding sections. Moreover, significant methodological differences are found in the modeling efforts. Regardless of these inconsistencies, it is interesting to examine a selection of this research to get a stronger understanding of the literature on estimated benefits.

Table 1 outlines the key findings and important distinguishing characteristics of a number of prominent studies found in the literature. For additional discussion of the trends in the differences between the preponderance of “green job” studies, refer to Wei et al. [35].

As mentioned above, because of the wide variety of factors involved in these studies (methods, inputs, energy focus, and time frames, etc.), it is difficult to draw distinct conclusions from this table for the purposes of this paper. Instead, with a practitioner focus in mind, we aim to demonstrate how researchers are increasingly demonstrating job effects. Accordingly, this table is organized with a focus on jobs. Just under half of these studies report job figures as measured by unit of energy output. This seems to be particularly helpful for practitioners comparing job creation within the types of energy technologies deployed. For example, Sastresa et al. [36] show that solar thermal creates 43 jobs/MW (photovoltaic, or PV) and wind creates 0.86 jobs/MW in Aragon, Spain.

One can also estimate the total number of jobs that will result depending on which energy technologies or renewable energy standards are adopted. For example, the American Solar Energy Society estimates the number of jobs to be created in renewable energy and energy efficiency under basic, moderate, and advanced scenarios of industry growth.

Only one study [37] explicitly looked at the job loss and job creation aspect as an impact, demonstrating the importance of measuring the positive and negative effects of turbulence in regional economies. Other forms of describing impact, shown in the last two rows of the table, are multipliers and effects on gross domestic product.

A final important finding from this review is that the literature is composed almost entirely of modeling estimates performed before EBED implementation, rather than assessment of effects

Table 1
Measuring energy-based job creation.

Assessment category	Reference	Economic impact results	Energy technology evaluated	Pre/post	Region examined
Jobs per energy output	Sastresa et al. [36]	Jobs/MW: 0.86 wind 43 solar thermal 38 photovoltaic 1.38 total weighted average	Wind and solar (thermal/ photovoltaic)	Post	Aragon, Spain
	Moreno and Lopez [40]	Wind (13.2 jobs/MW) Solar thermal (7.5 jobs/1000 m^2) Solar photovoltaic (37.3 jobs/MW peak) Biofuels (6.5 jobs/1000 tons/year) Hydroelectric (20 jobs/MW) Biomass thermal (0.121 jobs/tep) Biomass-electric (4.14 jobs/MW) Biogas (31 jobs/MW)	Wind, solar thermal and photovoltaic, biofuels, Hydroelectric, biomass thermal and electric, biogas	Pre	Asturias, Spain
	Simons and Peterson for the Electric Power Research Institute and California Energy Commission [41]	Jobs/MW: Wind (2.57 constr., 0.29 O&M) Geothermal (4.00 constr., 1.67 O&M) Biomass (4.29 constr., 1.53 O&M) LFG/biogas (3.71 constr., 2.28 O&M) Solar thermal (5.71 constr., 0.22 O&M) Solar photovoltaic (7.14 constr., 0.12 O&M) Small hydroelectric (5.71 constr., 1.14 O&M)	Wind, geothermal, LFG-biogas, biomass, solar thermal, solar photovoltaic, small hydroelectric	N/A	California
	Pedden for the National Renewable Energy Laboratory [42]	Meta-analysis of 13 existing studies found that jobs-per-megawatt ratio of wind in rural communities is highly variable, ranging from 0.36 to 21.37. Ratio appears highly dependent on existing skills in the community	Wind	N/A	United States
	Kammen et al. [43]	Total average employment for energy technology (both manufacturing and installation and ongoing O&M): Photovoltaic, 7.41–10.56 jobs/MWa Wind, 0.71–2.79 jobs/MWa Biomass, 0.78–2.84 jobs/MWa (MWa refers to average installed megawatts derated by specified capacity factor of the technology.)	Photovoltaic, wind, biomass	N/A	United States
Jobs per energy output + other factors	Blanco and Kjaer [44]	Data from 2007: 15.1 jobs created/MW of installed capacity Additional 0.4 jobs/MW of cumulative capacity in O&M and other activities Modeling efforts predicted wind capacity to grow from 55 GW in 2007 to 300 GW in 2030, with a resultant doubling effect of direct wind energy employment (from 154,000 to 377,000 employees)	Wind	N/A	European Union
	Calzada Alvarez [37]	Each "green" megawatt installed destroys 5.28 jobs, on average, elsewhere in the economy: 8.99 by photovoltaics 4.27 by wind energy 5.05 by mini-hydroelectric Since 2000, Spain has spent €571,138 to create each "green job," including subsidies of more than €1 million per wind industry job. Associated programs resulted in the destruction of nearly 110,500 jobs elsewhere in the economy, or 2.2 jobs destroyed for every "green job" created	Photovoltaic, wind, small hydroelectric	Post	Spain
	Singh and Fehrs [45]	Solar (2-kW plant) = 35.5 person years/MW Wind (37.5-MW plant) = 4.8 person years/MW Biomass co-firing (100–750 MW) = 3.8–21.8 person years/MW If impact is calculated per monetary unit invested, the effect of renewable energy sources on the creation of employment is around 1.4 times greater per $1 million invested than in a coal-fired thermal power station over the same period of time	Wind, solar photovoltaic (small scale), biomass co-firing	Pre	United States
Total jobs	Bezdek for the American Solar Energy Society. [46]	Base case scenario: RE jobs increase 190% from 2006 levels, from 446,000 to 1.3 million; EE jobs increase 85%, from 8 million to 15 million Moderate case scenario: RE jobs increase 600%, to 3.1 million; EE jobs increase 122%, to 17.8 million Advanced scenario: RE jobs increase 1700%, to 7.9 million; EE jobs increase 300%, to 32 million	Wind, solar, hydroelectric, biomass, geothermal, biofuels, energy efficiency	Pre	United States
	Prepared for GridWise Alliance by KEMA, Inc. [47]	Potential disbursement of $16 billion in smart grid incentives projected to catalyze smart grid projects worth a total of $64 billion. Projects would lead to 280,000 jobs in the deployment stage, with 140,000 new direct jobs becoming permanent, ongoing positions	Smart grid technologies	Pre	United States

Table 1 (*Continued*)

Assessment category	Reference	Economic impact results	Energy technology evaluated	Pre/post	Region examined
	Lehr et al. [48]	Model predicts overall employment impact to be positive, with a projection of 400,000 employees in the renewable energy industry in Germany in 2030	The whole industry of technologies for the use of renewable energy, including heat systems and biofuels	Pre	Germany
	Wei et al. (2010) [35]	Many scenarios are discussed and conclusions drawn in the modeling efforts, highlighted most notably by the following: A national Renewable Portfolio Standard of 30% by 2030, coupled with a "moderate EE scenario" (0.37% reduction in annual energy consumption), can create over 4 million job-years beyond business as usual Increasing nuclear generation to 25% and CCS to 10% of total generation can generate an additional 500,000 job-years	Renewable energy, energy efficiency, CCS, nuclear power	Pre	United States
	Algoso and Rusch for the NJPIRG Law and Policy Center [49]	Installed capacity of 10,200 MW of wind energy projected to create equivalent of 11,100 year-long jobs in manufacturing and installation, 740 permanent O&M jobs, and 12,700 indirect jobs. Jobs/MW ratio: 2.48	Wind	Pre	Maryland, Delaware, New Jersey, Pennsylvania
Total jobs + other factors	Hillebrand et al. [50]	Expansive effect found from increases in renewable energy installation and contractive effect resulting from an increase in production cost of power. An estimated increase of 33,000 new jobs is expected in 2004; however, the contractive effect offsets these gains, and ultimately the net job balance in 2010 will be slightly negative (−6000 jobs)	Renewable energy technologies eligible for German Feed-in Tariff, 2004–2010	Pre	Germany
	Laitner and McKinney [34]	The studies reviewed show an average 23% efficiency gain with a nearly 2-to-1 benefit–cost ratio. This set of studies suggests that a 20–30% gain in energy efficiency estimated within the U.S. economy might lead to a net gain of 500,000–1,500,000 jobs by 2030	–	Pre	United States
	Roland-Holst [32]	From 1972 through 2006, California energy efficiency measures have allowed state residents to redirect their spending to other goods and services in the economy, creating the equivalent of approximately 1.5 million full-time jobs (total payroll $45 billion) and household energy savings of $56 billion For every 1 job lost in the energy supply chain, more than 50 have been created economy-wide Looking forward, 100% compliance with Assembly Bill 32 greenhouse gas emissions regulations is projected to increase gross state product by $76 billion and create more than 400,000 new efficiency and climate action–driven jobs. The first 1.4% of annual efficiency gains estimates the creation of 181,000 additional jobs, with an additional 1% yielding 222,000 more	Economy-wide analysis, not limited to specific set of technologies	Pre and post	California
	Williams et al. [51]	For a 60-MW wind project in Coconino County, the estimated range of construction jobs (90% likelihood) was found to be 59–149. Ongoing O&M jobs were projected at 26–42. During the construction phase, estimated local economic activity generated by the wind project was found to be $4.3–11.2 million annually; during O&M this activity was projected at $0.78–1.32 million. Differences in local economies between Coconino and Navajo counties led to slight to moderate variances in results for Navajo County	Wind	Pre	Navajo and Coconino counties, Arizona
Gross domestic product	Ragwitz et al. [52]	Current European Union RE policies could result in an increase of gross domestic product (GDP) of 0.11–0.14% by 2020, and 0.15–0.30% by 2030. More aggressive policy assumptions could increase GDP by 0.23–0.25% by 2020 and 0.36–0.40% by 2030 (including moderate exports of RE technologies) As far as employment, jobs would be stimulated by Renewable Energy Standard policies, but the results should be expected to be more moderate than the GDP effects	All renewable energy technologies with European applications (or European manufacturing potential)	Pre	European Union
Multipliers	MacGregor and Oppenheim [33]	Investing in low-income energy efficiency was calculated to have an average local economic multiplier of 23 in the states evaluated, an estimated 2.7 times greater than the multiplier of an equal investment in the local manufacturing sector	Energy efficiency	Pre	Arkansas, Louisiana, Texas, Mississippi,

CCS, carbon dioxide emissions capture and sequestration; constr., construction; EE, energy efficiency; GW, gigawatt; LFG, landfill-derived gas; MW, megawatt; N/A, not applicable; O&M, operations and maintenance; RE, renewable energy; RES, renewable energy standard.

after implementation. Studies that were performed before EBED implementation are designated as "pre" in the table; studies that were performed after EBED implementation are designated as "post." These trends highlight the relative youth of the field and the dearth of practical experience for the literature to draw from, particularly in the United States.

Although most of the literature has focused on the positive effects associated with EBED, these studies are also accompanied by critics, who raise concerns about the methods of accounting for green jobs, the efficacy of using public funds for energy projects instead of for other capital-intensive efforts, and the possibility of energy expenses' crowding out other business investments. For further discussion of these critical points, as well as others, see recent work by Calzada Alvarez, Center for Energy Economics, and Morriss [37–39].

5.3. Evaluation methods

A growing number of studies consider how to effectively measure the effects of EBED-related activities and initiatives. Evaluation methods vary, but most of the research is focused on new approaches for economic modeling using input/output techniques and analytical approaches. Most of these approaches seek to determine the economic impact from the growth in the energy supply and energy efficiency industry in the form of job creation [35,48,50,53]. Scott et al. [54] provide additional quantitative measures, such as energy saved (in Btus), cost savings in investments in building stocks, and effect on national earnings. Within this economic impact literature, research typically focuses on the effects of specific policy interventions, such as those from solar thermal electricity deployment [55], wind energy projects [51], and smart grid deployment [56]. Others have used integrated approaches with a combination of input/output and other models to determine effects on other aspects of development, such as human capital and technological development [57] and local sustainability [58]. At times the economic modeling is supplemented with case studies to further describe the context of the economic impact [46].

The literature focuses less extensively on evaluation methods other than input/output. A couple of noteworthy exceptions include those who uphold logic models as an effective way to track inputs, outputs, and outcomes of EBED efforts [59,60] and those who advocate for "development assistance criteria" to guide and evaluate EBED efforts. The criteria for evaluation within this paradigm are relevance, efficiency, impact, and sustainability [60]. Houser et al. [59] also suggest a set of "green recovery metrics" for the evaluation of large-scale federal stimulus funding; metrics include speed of implementation, employment, energy savings, reduction of oil imports, and climate change measures.

Although these evaluation tools are common in project implementation and policy intervention, the EBED discipline faces some particular challenges in the estimation of EBED effects. Most of the recent literature notes up front the significant gaps and deficiencies in measuring EBED effects, the reasons for which are numerous. One of the main reasons is that definitions for EBED, and EBED-related industries and activities, are inconsistent, which makes it difficult to aggregate relevant industry and workforce data for assessment. Additionally, assumptions, time horizons, and scenarios are inconsistent across the research [46]. Of great concern from an evaluation standpoint, many reports are not explicit about the methodological approach that they employ to measure EBED outcomes.[10] del Río and Burguillo [58] also note that impact evaluations in this space are typically completed at the national level, which leaves a void for robust evaluations at the local and regional levels in EBED.

5.4. The need for a comprehensive approach to energy-based economic development

Another subset of the EBED literature focuses on the need to incorporate EBED efforts into more comprehensive development initiatives or, alternatively conceived, to make EBED efforts more holistic in nature, so that they include multiple development criteria. McIntyre and Pradhan [62], for instance, state that focusing on energy advancement within an economic development plan accomplishes little unless broader issues of community mobilization, participatory community involvement, resource management, and gender disparities, among other topics, are considered. Many who contribute to this growing body of literature contend that energy issues, and their proposed solutions, are too often presented and conceived of in a fragmented manner, disconnected from other fundamental issues [25]. They assert that a more holistic approach to EBED, which seeks to address all of these issues simultaneously, will result in greater success than an EBED approach that merely isolates energy issues.

Contributors to the literature have focused on the relationship between advancements in energy supply and energy efficiency with increased levels of social sustainability. Udo and Jannson [63], for example, compared the characteristics of 132 nations, and found that high degrees of what they defined as "technological sustainability" were rarely found in concert with low measures of their definition of "social sustainability," including evaluations of human rights, corruption levels, income equity, and life expectancy, among others. In other words, high levels of technological progress tend to be associated with high measures of human and social development, a finding that underscores the importance of energy development's not existing in isolation from measures of social progress. Their findings led the authors to conclude that high measures of social sustainability are a "prerequisite" for energy advancement [63].

Other contributors to this topic have looked at this same issue from the other side [64–66]. These authors contend that efforts to improve energy efficiency and deploy advanced energy applications can play a critical role in improving the same social sustainability measures that Udo and Jannson reviewed in their analysis. The conclusions of this literature suggest that efforts to advance EBED would benefit from concurrent efforts to improve social sustainability indicators, because the two efforts exhibit synergy in pursuit of a comprehensive development regime.

Building from these studies, several contributions to the literature have discussed how to maximize the social impact of EBED job creation efforts. Such works discuss the importance of ensuring that programs contain measures of job quality standards, high levels of transparency, and substantial civic engagement [67,68].

Various authors also support the following opinions, both of which consider the comprehensive nature of EBED efforts: (1) in many cases, practices do not necessarily function much differently than standard economic development; and (2) EBED may often be inserted into presently existing economic development infrastructure and does not universally require the reinvention of new programs and public investment. Recent research on economic development in Minneapolis—St. Paul, for instance, focused largely on exploring the commonalities between clean EBED and conventional economic development practices [69]. Particularly with respect to nurturing home-grown industries and attracting investment and relocation from established firms, the principles often remain the same, as energy businesses generally share many

[10] The Pew Charitable Trusts *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America* [61] is an example of a current report that counters this trend, describing the determinations for industry classifications, etc.

of the same needs and perspectives as other businesses. Others describe EBED as simply the injection of greater consideration to energy issues into the preexisting economic development infrastructure and framework [67].

5.5. Obstacles to success in energy-based economic development

Some of the literature describes how, despite potential benefits of EBED initiatives, some obstacles to EBED's immediate success remain. Of primary importance, although the amount of investment in sustainable energy projects has increased nearly sixfold from 2002 to 2008 [70], inconsistent funding streams or policy mechanisms often complicate and, in some cases, can even thwart effective long-term EBED project planning [36,71]. On-again, off-again funding makes it difficult for industry actors, community stakeholders, and other involved parties to plan EBED projects, especially projects that take a long time to complete or require years of experience before they reach optimal performance. Consistent, predictable, and sustainable funding streams are therefore vital to the further development of this field and a successful transition toward sustained EBED practice.

Furthermore, although billions of dollars in stimulus funds have been allocated toward EBED projects, early reports indicate that the funding has, in some cases, outpaced the ability of the agencies to implement even some of their most "shovel-ready" projects. For example, a report on the ARRA weatherization program, toward which over $5 billion were allocated in fiscal year 2009, enumerated difficulties in the project implementation process, including "state hiring freezes, ... significant local budget shortfalls, and state-wide planned furloughs delayed various aspects of the program and contributed to problems with meeting spending and home weatherization targets" [72]. This again underscores the nascence of EBED infrastructure and the importance of maintaining realistic time frames for complete project implementation, particularly in the beginning stages of the field's development.

Continuing in that vein, even with performance metrics that are easy to understand and measure, the described benefits of EBED, and established techniques for some EBED activities (e.g., weatherization), the same Department of Energy report highlights that EBED may not be successful without the coordination of all the "moving parts" involved in a given program. In the federal weatherization program example described above, coordination among multiple interested parties—including several levels of governance, outside contractors, and grant subrecipients—compounded by the aforementioned state budget difficulties, a lack of availability of trained program staff, and concurrent changes in regulatory requirements, all proved to be unexpected complicating factors to successful EBED practice in the initial year of the program.

Although early assessments of ARRA accomplishments like this one demonstrate that funding for EBED in the United States has outpaced state and local governments' ability to successfully administer and allocate fiscal resources, one must also consider that these assessments are reporting on the early stages of project development and practice.

One should also note that, although some EBED funding existed before the global recession through both multinational development banks and local economic development agencies (through programs such as the Global Environmental Facility, the Clean Development Mechanism, and Renewable Energy and Energy Efficiency Partnership), funding behind EBED increased significantly in the wake of the economic crisis through national stimulus funds. The amount of these funds—approximately $180 billion worldwide [70]—reiterates the world's investment-backed expectations in the potential for energy-related projects to be an area for sustained economic development and growth.

6. Conclusions and suggestions for next steps

EBED solutions require an understanding for global circumstances, accompanied by local action and the efficient production of local energy-based resources. They also require public-private partnerships and a prominent role for policymakers, economic development practitioners, and energy users to facilitate the process of bringing new products to market, establishing appropriate infrastructure for more efficient energy use, cultivating a healthy business climate based on reliable energy supply and predictable costs, developing energy-related industry clusters, retooling workforce training to align with new skills requirements, and creating a quality of life for places that encourage sustainability as a part of community economic development. The alignment of energy policy and planning with economic development offers decision-makers an open window to create new policies and practices to meet these emerging challenges to communities.

This paper has contributed to the EBED field by demonstrating how economic development and energy policy and planning have evolved over the last 75 years or so and how they have converged to create an avenue for new policy interventions. In our research we have shown that funding in EBED has outpaced proven practice and evaluation techniques, which has potentially ignited the use of ambiguous terminology in the field, perhaps confounding policymakers, practitioners, and other stakeholders. We have attempted to define EBED as a practice and to establish goals and suggest approaches that offer a more solid framework from which practitioners can more meaningfully develop initiatives and interventions suited to the specific needs and conditions of their communities.

The exploratory nature of this paper provides ample opportunities for other researchers and practitioners to expand on in the future. First, we encourage researchers and practitioners alike to build on this working definition and process so as to improve the performance and effectiveness of EBED projects in the medium to long term. Second, with a heavy emphasis on pre-evaluation studies, we suggest that more post-project evaluations be conducted and documented to determine actual outcomes, and compare them with potential outcome estimates. This information will provide significant value to the field by better determining the impact and thus better communicating expectations for EBED in the future. Third, because the issues of EBED are prominent in the United States and internationally, in both advanced and emerging economies, we believe there will be great value in comparing and contrasting practice and outcomes between domestic and international regions implementing EBED techniques. The detail gained from more research and documentation for EBED will lend itself to better understanding of the EBED process and will add a more systematic result so that efforts can be implemented in a more consistent manner yet still tailored to meet distinct community and regional needs.

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